# Evaluation of Emerging Flash Flood Decision-Making Products and Tools in the HMT Multi-Radar Multi-Sensor Hydro Experiment

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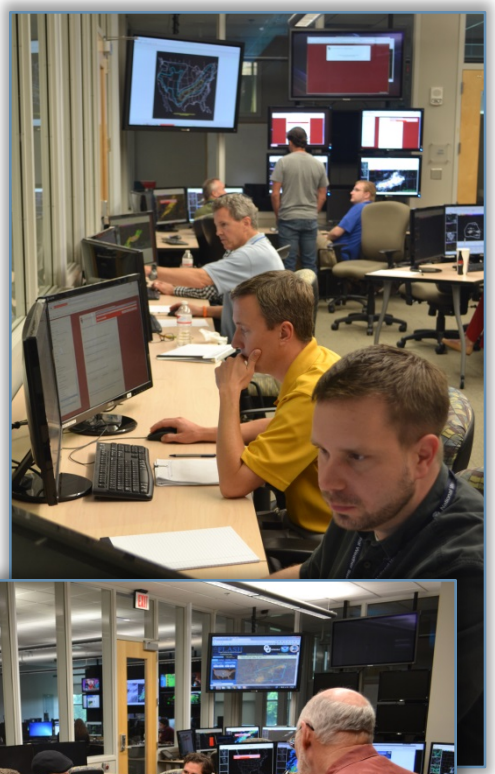
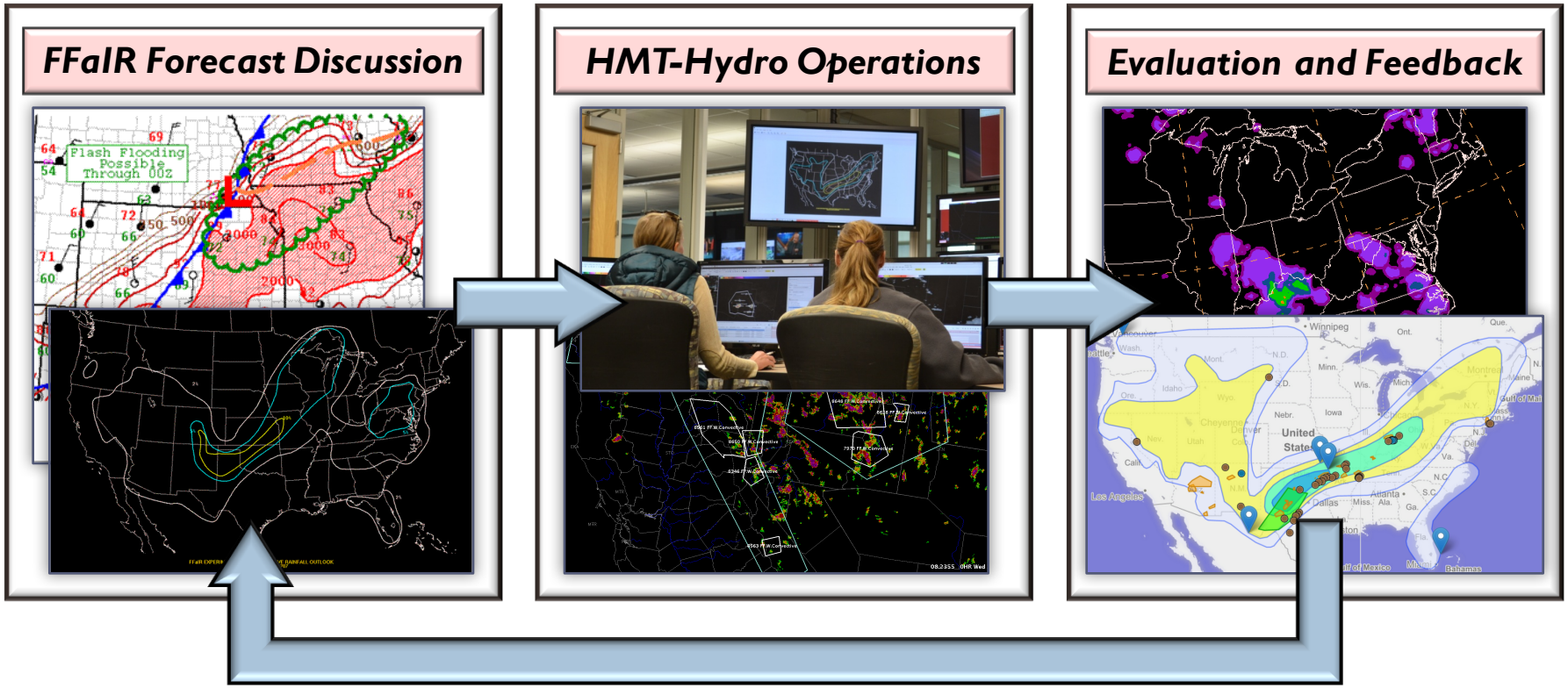
# Hydrometeorological Testbed Multi-Radar Multi-Sensor Hydro Experiment

- HMT-Hydro Experiment provided an opportunity to evaluate the following:
  - Multi-Radar Multi-Sensor (MRMS) and Flooded Locations and Simulated Hydrographs (FLASH) products
  - Short-term QPFs (HRRRX, ADSTAT)
  - Probabilistic information in watch/warning products
  - Hazard Services software and flash flood recommenders for warning generation



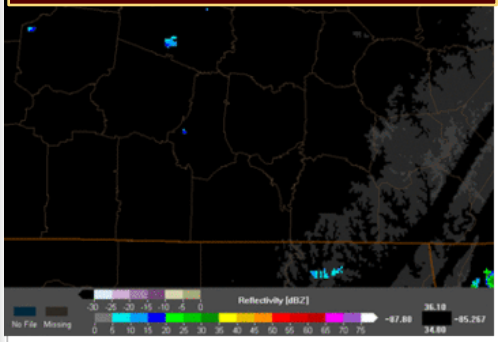
# Collaboration with Flash Flood and Intense Rainfall (FFaIR) Experiment



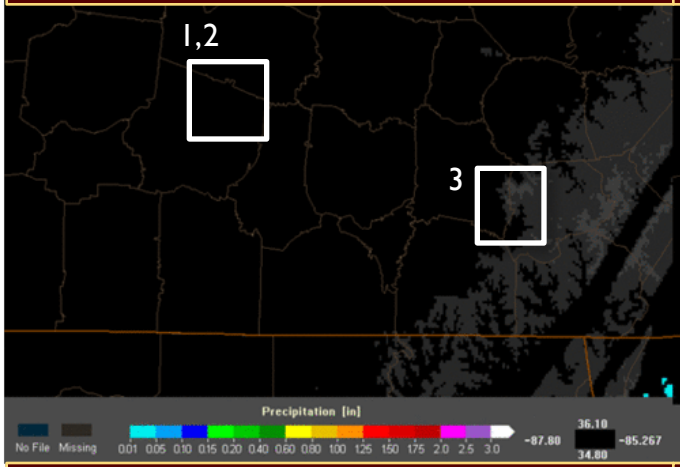

- Allowed for real-time simulation of workflow between WPC and NWS WFOs; Facilitated discussions on flash flood forecasting

# MRMS and FLASH Products Evaluated in HMT-Hydro Experiment

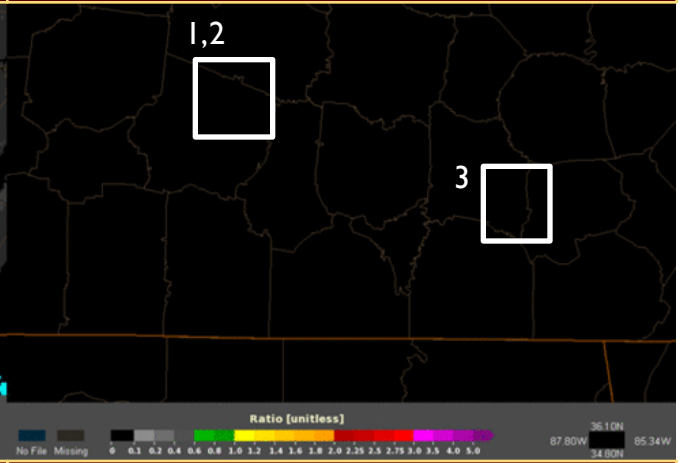
MRMS SHSR Reflectivity



MRMS 3 h Radar-Only QPE



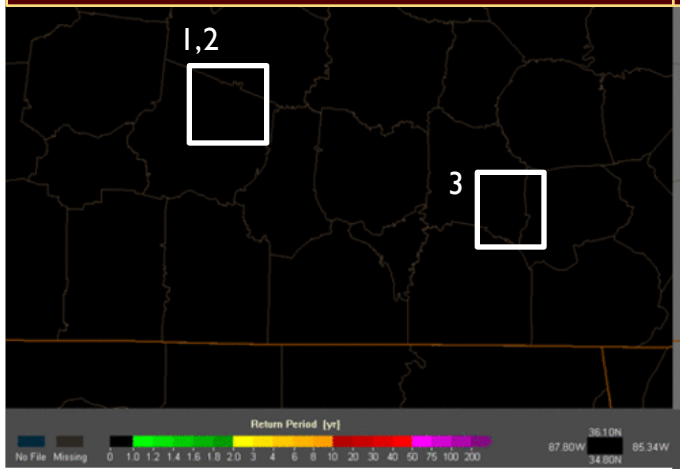

QPE-to-FFG Ratio



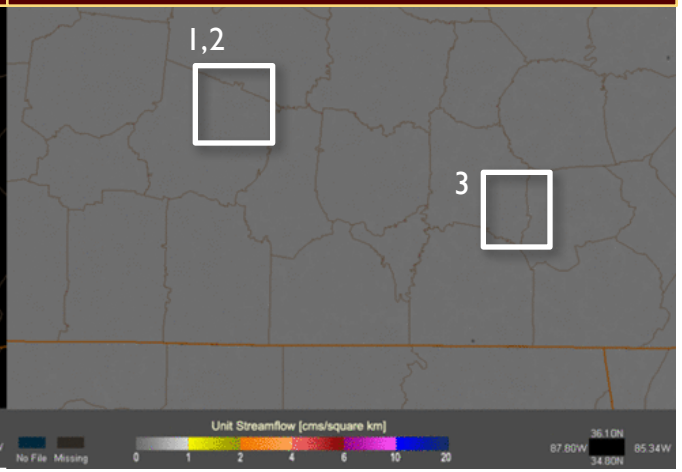

1200 UTC 1 October 2015 to
0000 UTC 2 October 2015

1) 2050 UTC: Several roads flooded and closed
2) 2230 UTC: Several roads and a parkway closed to flooding
3) 2155 UTC: Roads flooded and two homes surrounded by flood waters

MRMS QPE Average Recurrence Interval

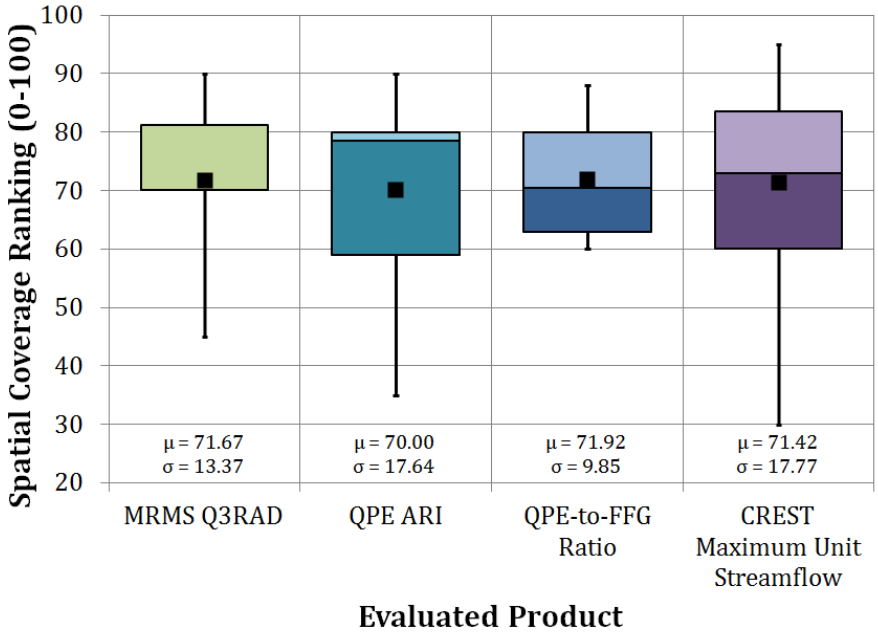


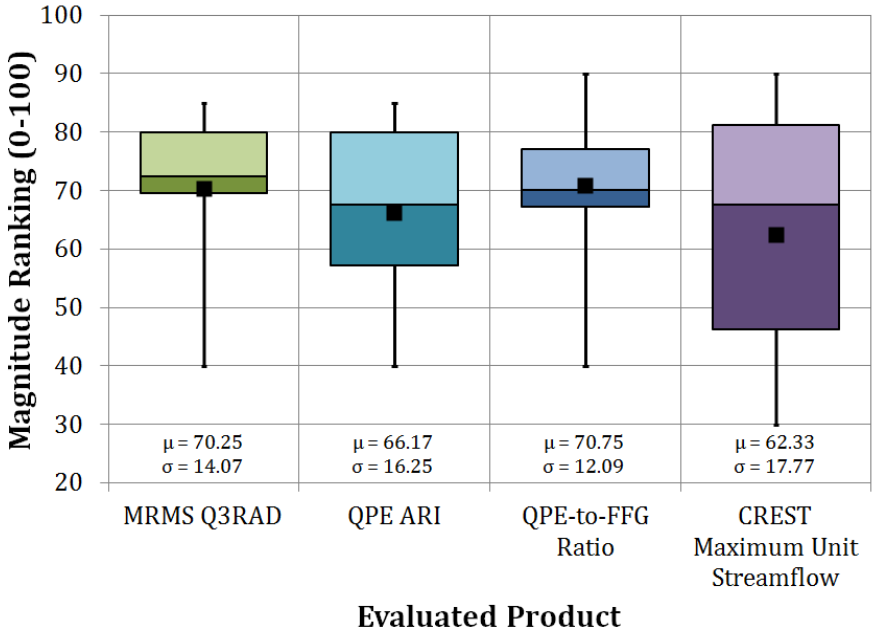

CREST Maximum Unit Streamflow




From http://mrms.ou.edu and http://flash.ou.edu

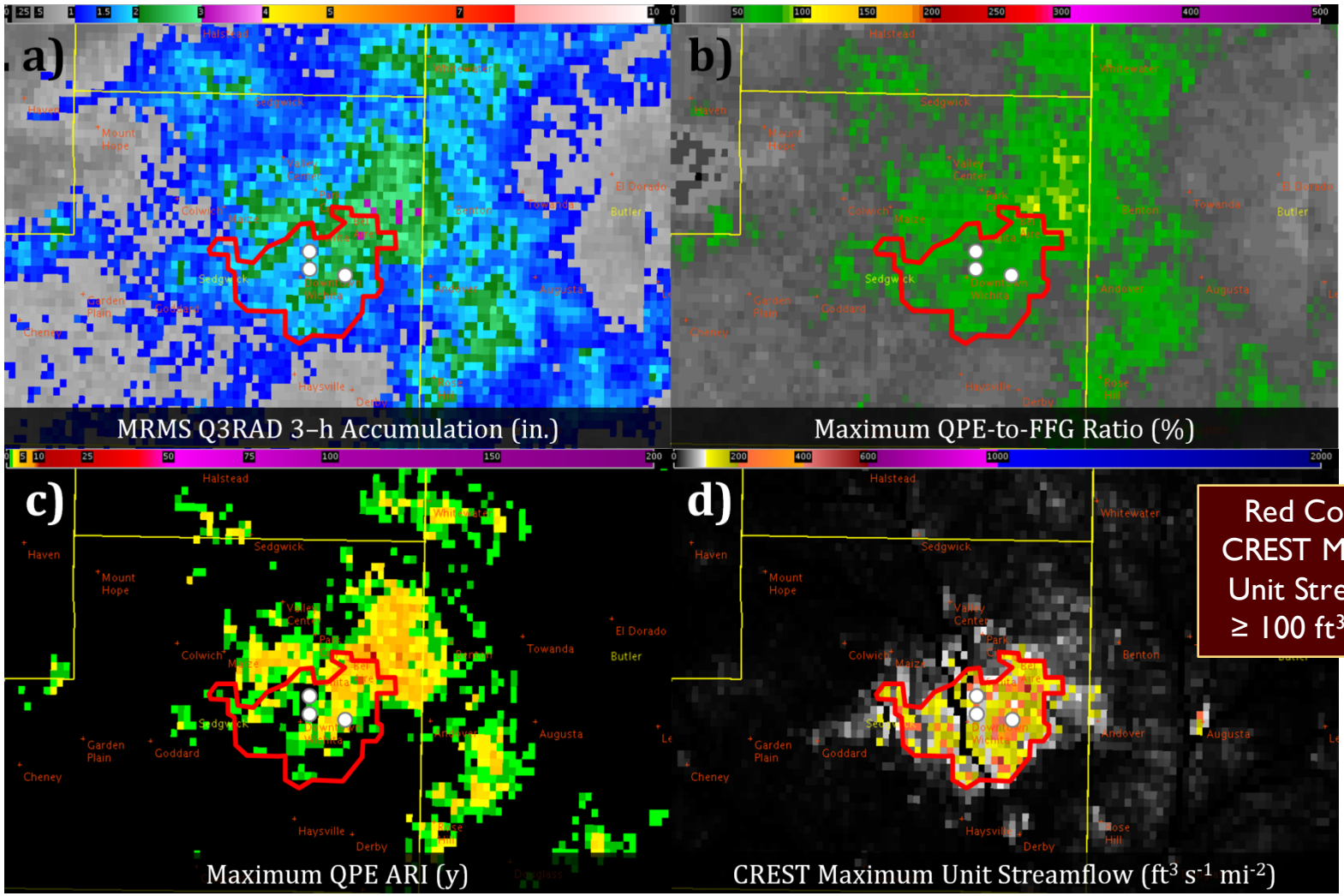
# Subjective Ranking of Evaluated Products during Flash Flood Events



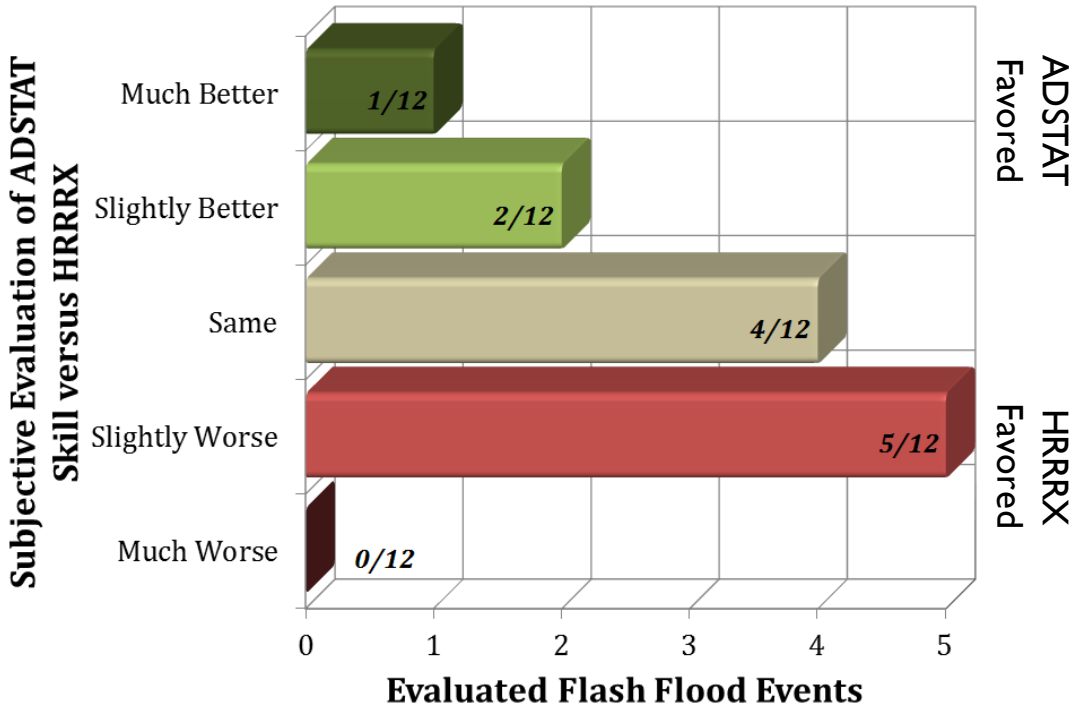




- All products had similar statistical values; QPE ARI and CREST Maximum Unit Streamflow had greater ranking variability
- No significant statistical difference between all products
- Ranking of CREST depended on terrain and land usage

# Noted Utility of FLASH CREST Maximum Unit Streamflow in Urban Areas



# Use of Short-Term QPFs in HMT-Hydro Operations



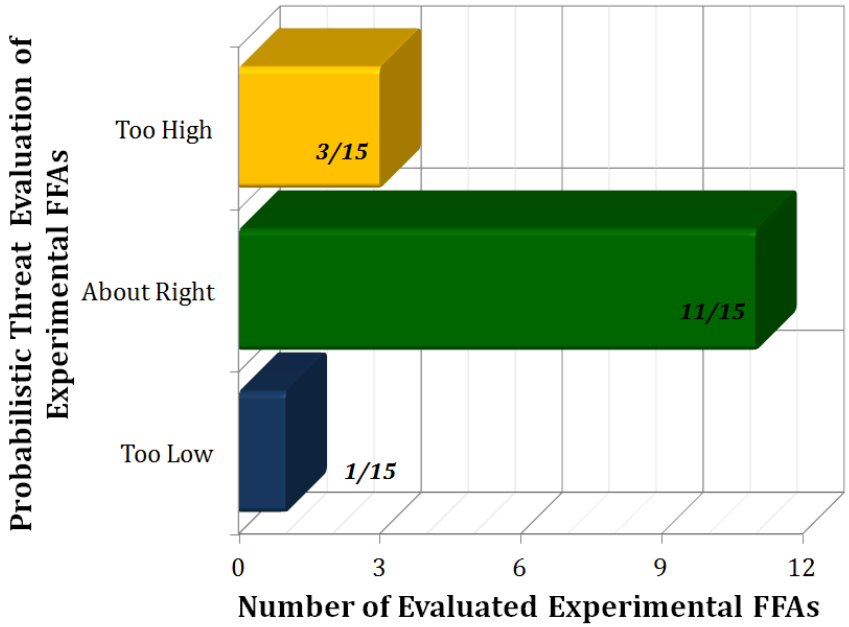

- *Reduced false alarm area*
- *Similar results from lack of QPF inputs*
- *Predictive skill with convective initiation*

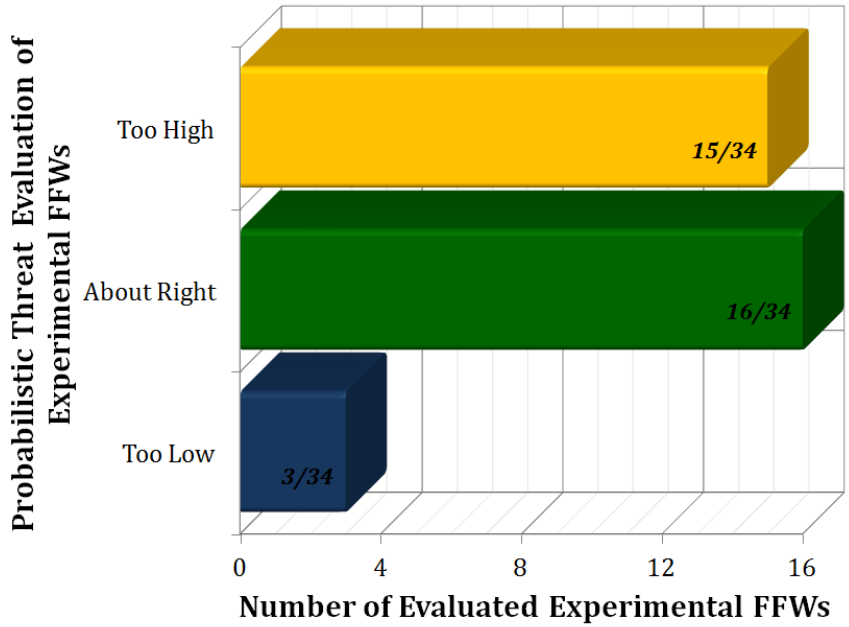
- Challenges with the spatial placement and coverage of convection and run-to-run inconsistencies limited use of QPFs in generating FFWs with greater lead time

# Experimental Flash Flood Watches and Warnings in HMT-Hydro Operations

- Forecaster-defined probabilistic information for "nuisance" and "major" flash flooding
  - Nuisance Flash Flooding: River or creek out of its banks, yard flooding, minor road flooding
  - Major Flash Flooding: Water in buildings, vehicles swept away, swift water rescues, evacuations
- Select experimental watches and warning evaluated the following day
  - Included is a subjective evaluation of the nuisance and major flash flood probabilities when compared to the local storm reports and products

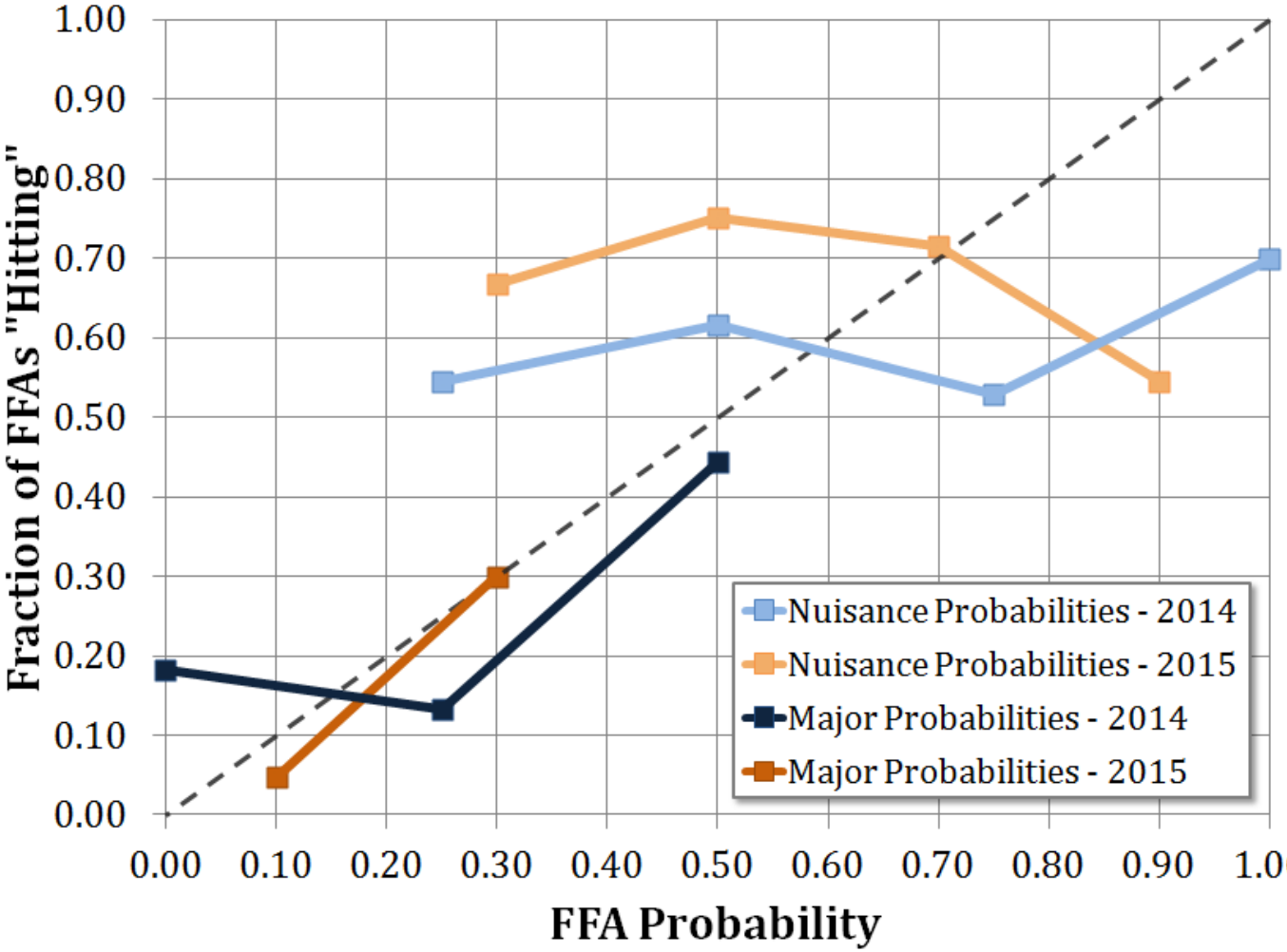
# Subjective Evaluation of Probabilistic Threat Information in Flash Flood Products

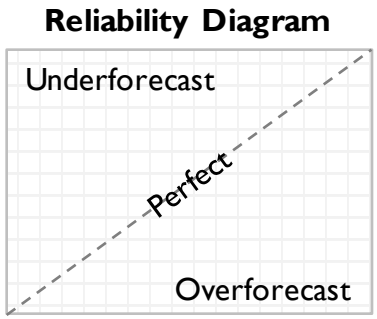


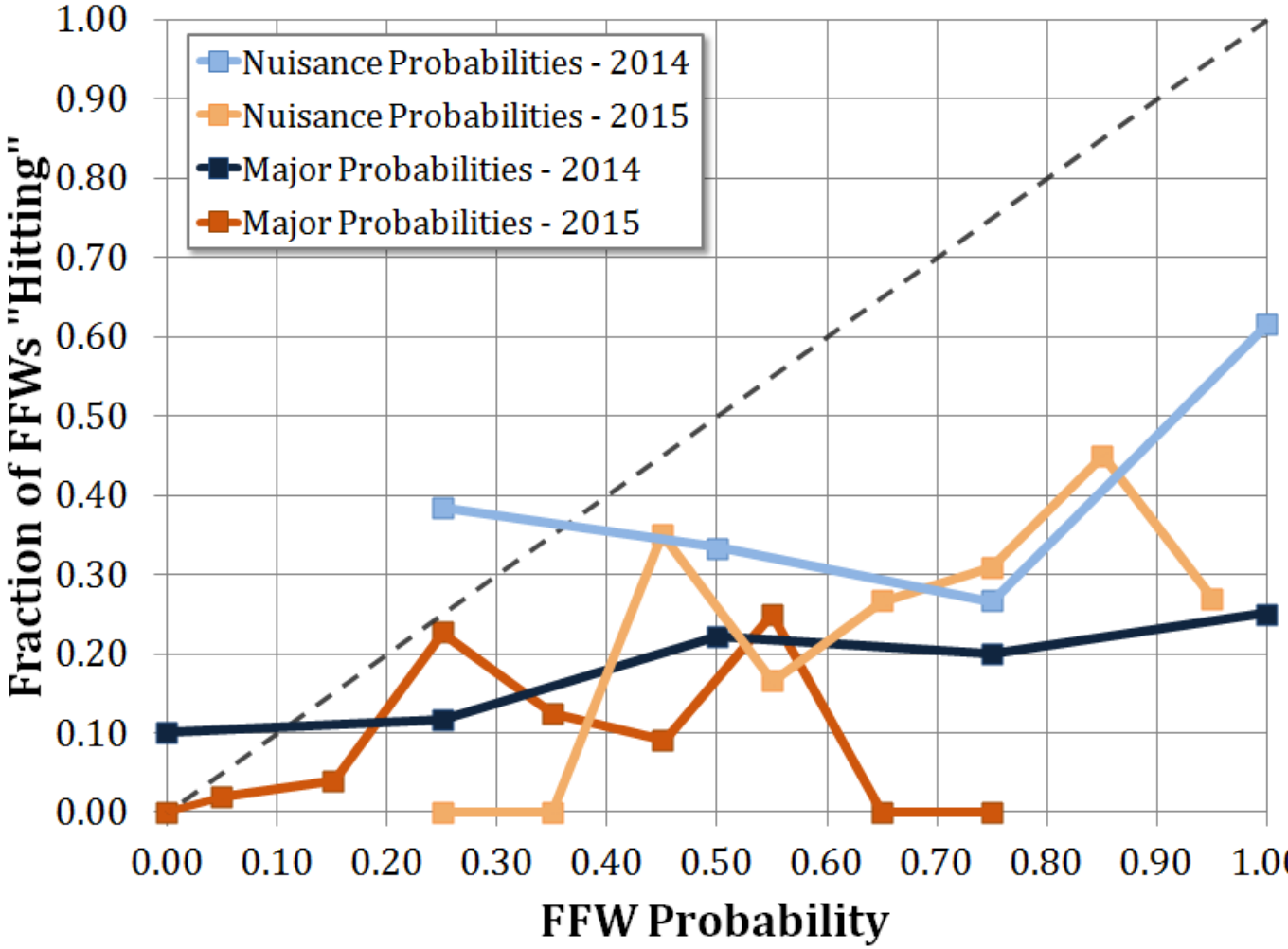

- Differences between operational and experimental warnings were generally due to type/coverage of LSRs and an over-forecasting of major flash flood probabilities

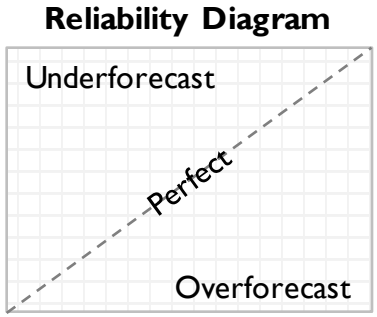
# Reliability of Probabilistic Forecasts for Flash Flood Watches



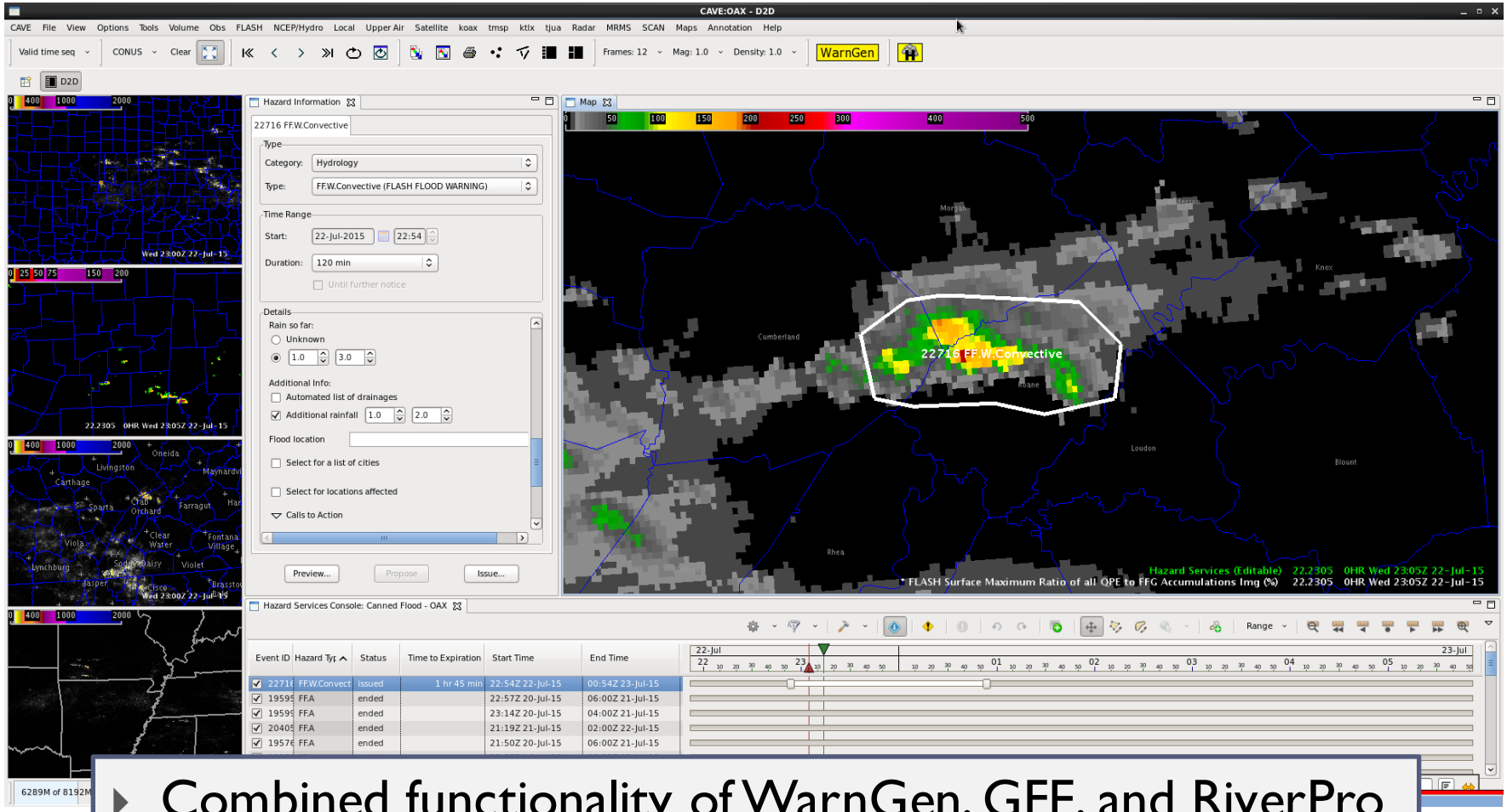



# Reliability of Probabilistic Forecasts for Flash Flood Warnings



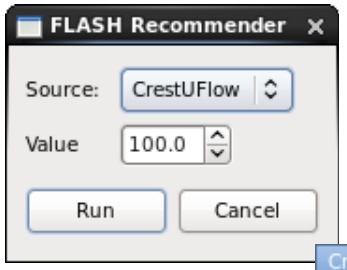
# Product Generation Using Hazard Services



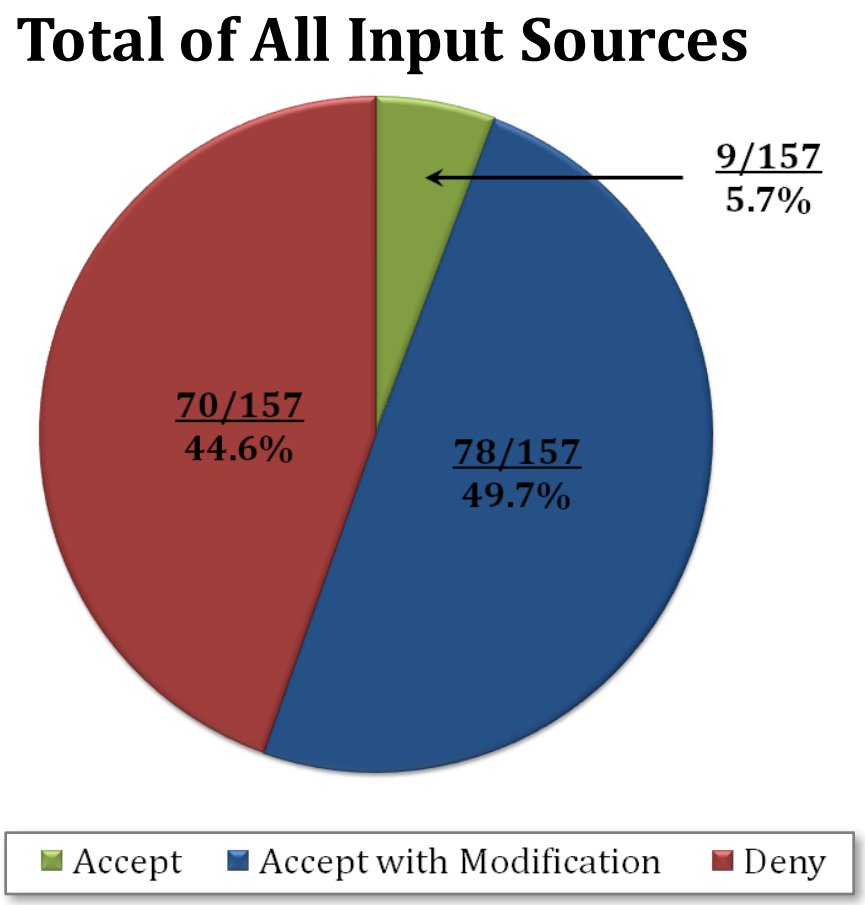

- Combined functionality of WarnGen, GFE, and RiverPro
- Expand and move warned polygons

# Testing Flash Flood Recommenders for Flash Flood Warning Generation

- Contours of a required area > 0.001 deg$^2$ (~ 10 km$^2$) generated from user-select threshold of the following products:
  - CREST Maximum Unit Streamflow
  - Maximum QPE ARI
  - Maximum QPE-to-FFG Ratio
  - MRMS 3–h Radar-Only QPE
- Turned into a polygon and individual hazard event (i.e., proposed warning polygon)
- Evaluated during specific periods within operations



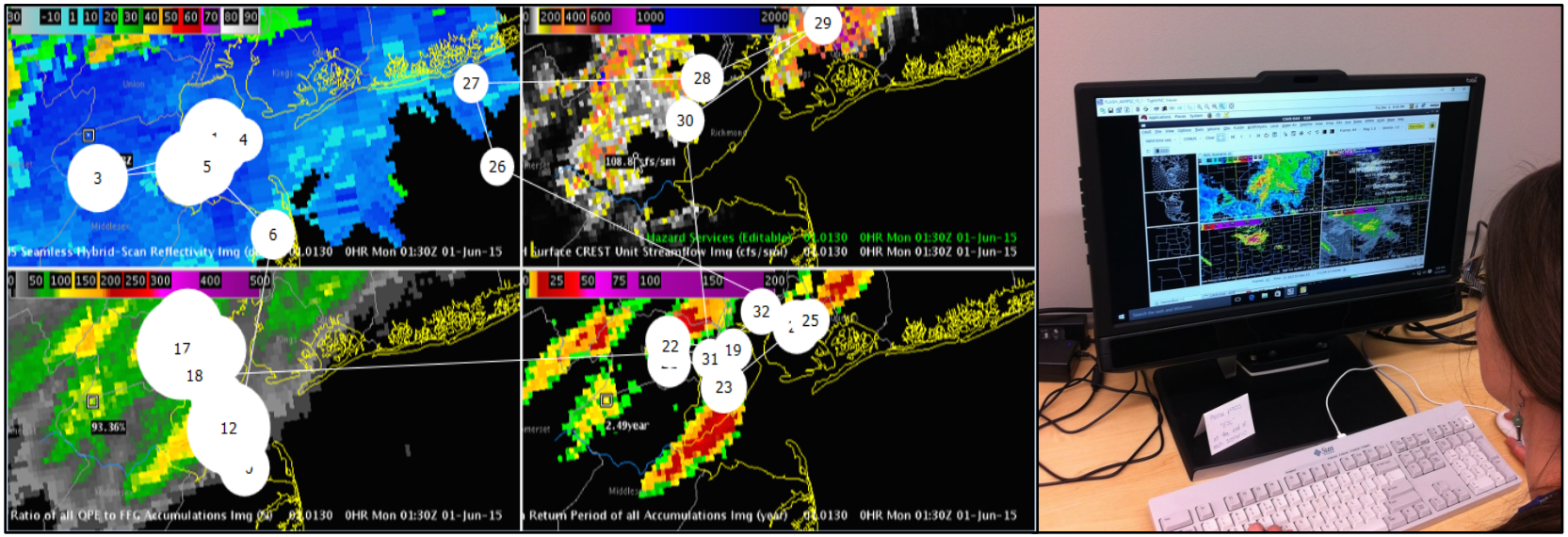

# Evaluation of FFW Polygons from Flash Flood Recommenders




- Added to the situational awareness process in identifying areas that could potentially have flash flooding
- Previous research has shown that there is an inverse relationship between automation and situational awareness

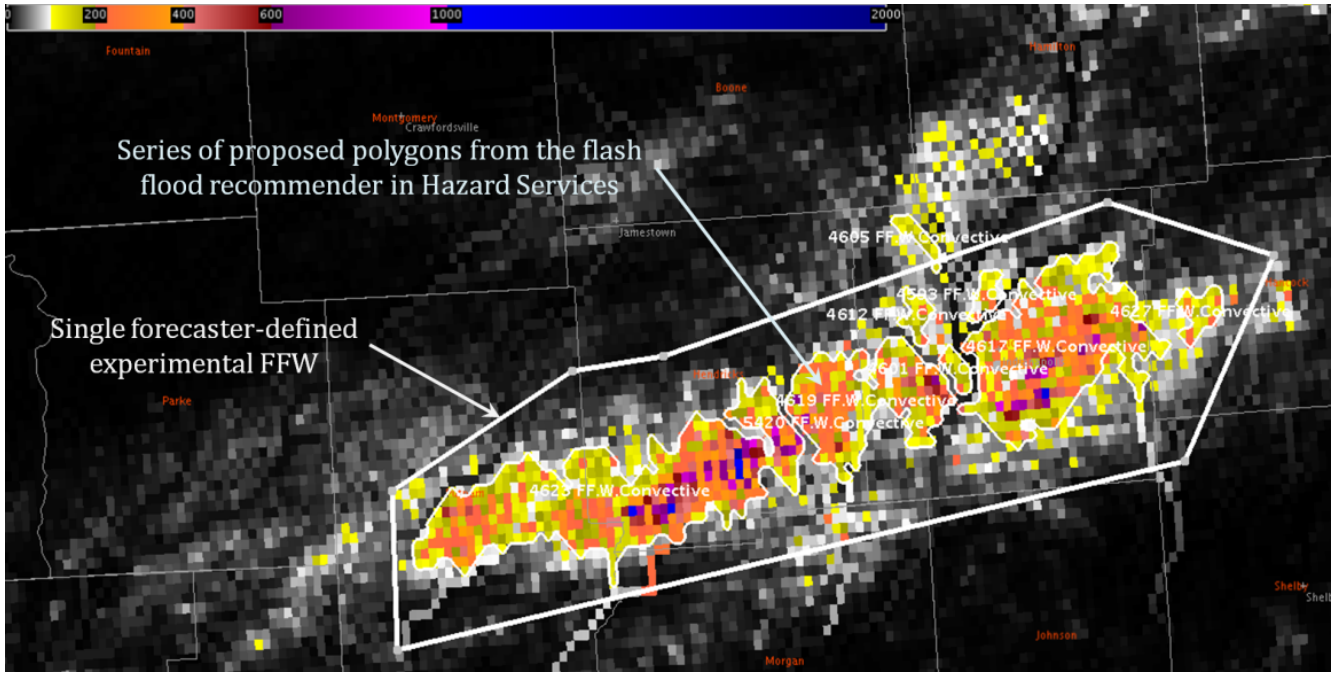
# Human Factors Research on Flash Flood Recommenders

- Evaluated the effect of using recommenders on situation awareness (SA) using eye tracking software to investigate information-seeking behavior
- Findings suggest that recommenders influence guidance usage, and do not decrease SA



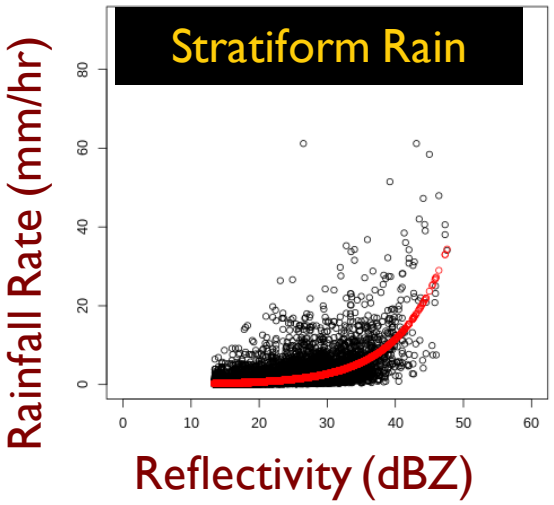
# Observations About Using Flash Flood Recommenders

- Clustering of polygons led to small gaps in between, which can be rectified by a single user-defined polygon
- Polygons likely do not portray downstream impacts or storm motion

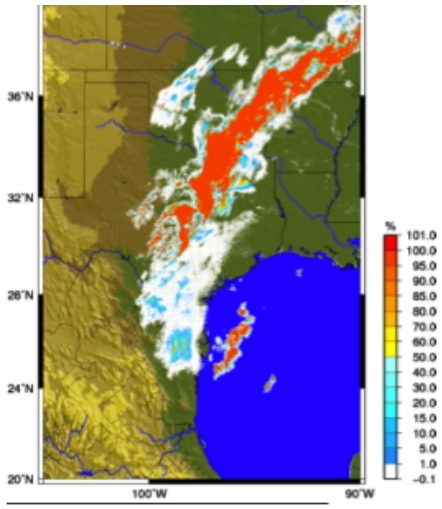


# Future Assessments in HMT-Hydro Experiment

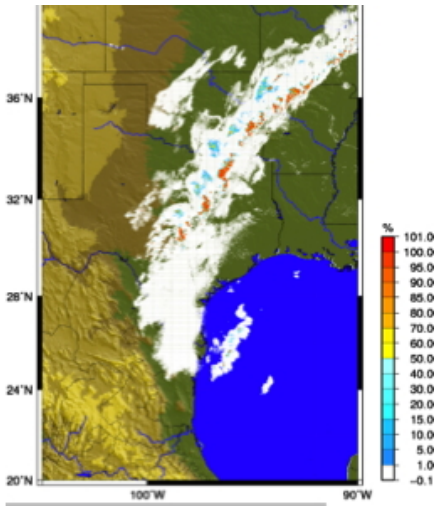
- Probabilistic QPE and probabilistic hydrologic model output in forecast decision making
- Create probabilities exceeding certain QPE threshold

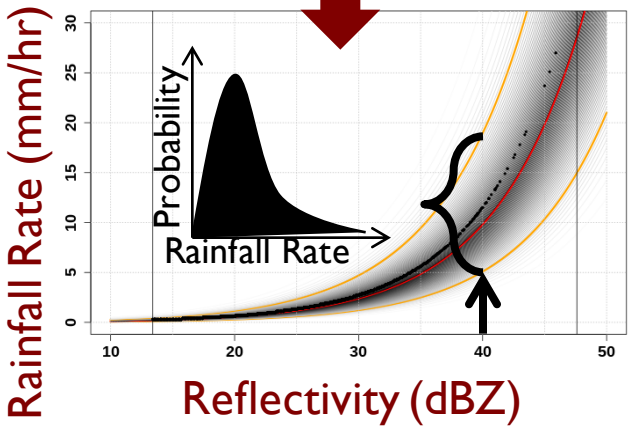



PQPE > 1 mm h$^{-1}$



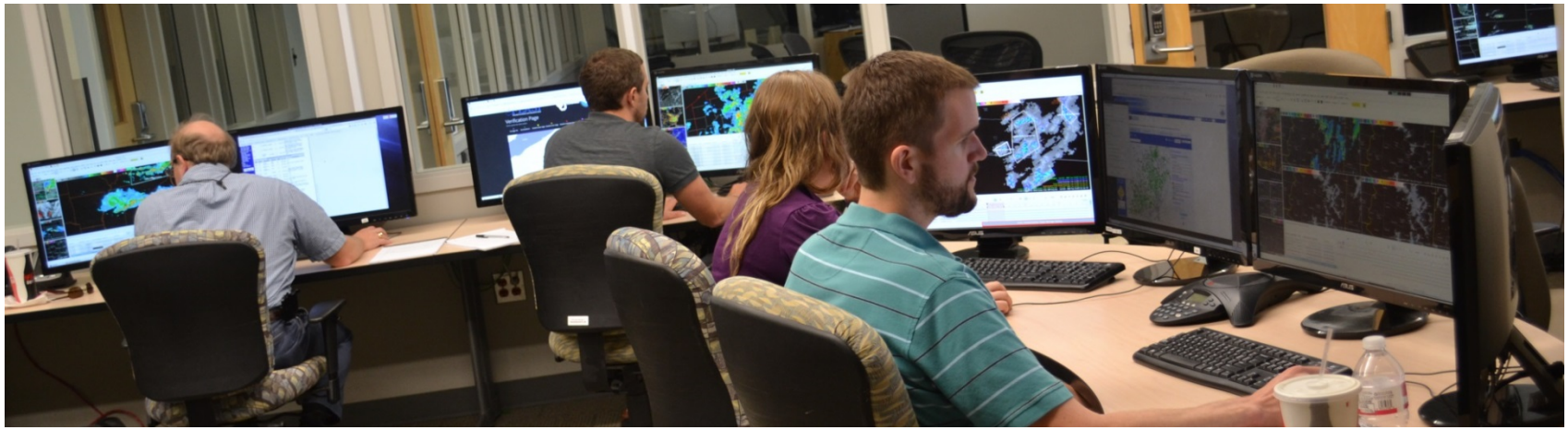
PQPE > 20 mm h$^{-1}$





# Future Assessments in HMT-Hydro Experiment

- Improve capability of flash flood recommenders using multiple variables and probabilistic grids
- Warning decision best practices as products and technology become operational
- Evaluate any new products/software/models relevant to flash flood prediction



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# Thank you

http://flash.ou.edu

http://mrms.ou.edu